(19) Japan Patent Office (JP)

(12) Publication of Laid-Open Patent Application (A)

(11) Publication Number of Patent Application: 6-123896

(43) Date of Publication: May 6, 1994

(51) Int. Cl.[5]	Identification Mark	FI
G02F 1/136	500	9018-2K
H01L 29/784		
		9056-4M H01L 29/78 311 C

Request for Examination: Not requested

Number of Claims: 1

(Total 6 pages)

(21) Application Number: Japanese Patent Application No. 4-274168

(22) Date of Filing: October 13, 1992

(71) Applicant: 000003078

Toshiba Corp.,

72 Horikawa-cho, Saiwai-ku, Kawasaki-shi, Kanagawa-ken

(72) Inventor: Hiroyoshi Nakamura

c/o Toshiba Corp., Yokohama Works

8 Shinsugita-cho, Isogo-ku, Yokohama-shi, Kanagawa-ken

(74)Representative: Patent Attorney Saichi Suyama

(54) [Title of the Invention]

Liquid Crystal Display Device

(57) [Abstract]

[Object] In a switching thin film transistor for video signal writing of a liquid crystal display

device, to make ON-resistance lower, to make a period for writing shorter, and to reduce division number of a video signals.

[Structure] In a liquid crystal display device, a signal line scanning circuit includes a video signal processing portion and a video signal writing thin film transistor which writes a video signal from the video signal processing portion to a signal scanning line, wherein the video signal writing thin film transistor is formed by connecting in parallel a plurality of thin film transistors which are formed by hydrotreatment, and each channel width of the thin film transistors which are connected in parallel is 1μm or more and 30 μm or less.

[Scope of Claim]

[Claim 1]

A liquid crystal display device including a substrate, a plurality of display pixel portions formed in a two-dimensional state over the substrate, a plurality of switching thin film transistors each of which controls each of the display pixel portions, and a driving circuit portion for driving the thin film transistors in order having a signal line scanning circuit and a gate line scanning circuit over the substrate, characterized in that the signal line scanning circuit includes a video signal processing portion and a video signal writing thin film transistor which writes a video signal from the video signal processing portion to a signal scanning line; the video signal writing thin film transistor are formed by connecting in parallel a plurality of thin film transistors which are formed by hydrotreatment, and each channel width of the thin film transistors connected in parallel is 1μm or more and 30 μm or less.

[Detailed Description of the Invention]

[0001]

[Industrial Field of the Invention]

The present invention relates to a display device, and especially relates to an active matrix type liquid crystal display device with a driving circuit integrated.

[0002]

[Prior Art]

Since a liquid crystal display device recently has had great advantages such as thin type, light weight, and low power consumption, various liquid crystal display devices are applied to OA devices such as a liquid crystal television, a word processor for Japanese, and a desktop personal computer, and the like. It is required to have a display characteristic with higher quality than the active matrix type liquid crystal display device with a driving circuit integrated which can display with high quality.

[0003]

A partial circuit diagram of a conventional active matrix type liquid crystal display device with a driving circuit integrated is shown in FIG. 7. In the structure of the conventional active matrix type liquid crystal display device with a driving circuit integrated, driving circuits such as a shift register 1, a buffer 2, and a switching thin film transistor for video signal writing 3 are formed over a substrate by using a thin film transistor including polycrystalline silicon, and a switching thin film transistor 5, which controls a plurality of display pixel portions 4 formed in a two-dimensional state over the same substrate, are driven in a dot-sequential manner. Note that a numeral 6 shows a signal line; 7, a gate line; and 8, a gate scanning line driving circuit. Herein, the switching thin film transistor for video signal writing 3 is designed so that a video signal can be written within the required time for writing by forming a channel width widely and making ON-resistance lower. Usually the channel width is 300 to 400 μm; however, punch-through voltage due to a capacitance between a gate and a drain of the switching thin film transistor for video signal writing 3 is increased if the channel width is further widened (SID' 90 DIGEST P315). Thus, the width has a limitation.

[0004]

On the other hand, in the polycrystalline silicon thin film transistor, drain-leak current is easily generated at an OFF-side of transistor operation which causes degradation of contrast of a liquid crystal display device. Further, mobility needs to be enhanced for

improving a characteristic of a polycrystalline silicon thin film. Therefore, usually hydrotreatment is performed for lowering the drain-leak current and enhancing the mobility in the polycrystalline silicon thin film transistor. The hydrotreatment is related to a channel width. Since the efficiency of the hydrotreatment is degraded when the channel width is widened, a method in which a slit is put in a channel portion so as to form an opening portion has been disclosed (Patent Application Laid-Open No. S62-268161).

[0005]

[Problems to be solved by the Invention]

However, if the high quality of image display is enhanced by a shift from current television broadcast standard (NTSC) to high vision broadcast standard, and a shift from interlace driving to non-interlace driving or the like, the time for writing a video signal into a switching thin film transistor for video signal writing 3 is shortened. And in a case of a dot-sequential driving method, there is a problem that writing is difficult.

[0006]

As a means to make a period for writing a video signal longer, a means to divide a shift register and a video signal can be considered. However, as for the division of a video signal, increase and adjustment of an external driving circuit are difficult. Therefore, it is desirable to reduce division number of video signals or make ON-resistance of the switching transistor for video signal writing 3 lower so as to do without division; however, there is a limitation in the channel width as mentioned above, and the method for conducting hydrotreatment after putting a slit in the channel portion so as to form the opening portion has the following problem. In a case where a narrow opening portion is formed in the channel portion and its opening pattern width is formed by etching, the corner of a square opening portion has roundness or it is difficult to form an opening portion itself. Further, if the width of the opening portion is narrow, voltage endurance of a gate electrode becomes worse at an end portion of an active layer.

[0007]

Further, in a case where a liquid crystal display device with a driving circuit

integrated is hydrogenated, a channel width of a thin film transistor exists as a narrow pattern in the shift register or the like and it exists as a wide pattern in a video signal writing thin film transistor, a buffer circuit, and a thin film transistor of a protection MOS diode. Thus, when a hydrotreatment is conducted in a proper time for a channel width of a video signal writing thin film transistor or the like, the hydrotreatment becomes excessive in the shift register or the like, and a depression phenomenon of a thin film transistor in a driving circuit portion is generated. And further, a leak-current at OFF-time is increased, power consumption is increased, and a problem such as heat generation occurs.

[0008]

The present invention is made for coping with such a problem, and it is an object to provide a liquid crystal display device which can make ON-resistance of a switching thin film transistor for video signal writing lower, make a period for writing shorter, and reduce division number of video signals in a liquid crystal display device with a driving circuit integrated.

[0009]

[Means for Solving the Problem]

A liquid crystal display device of the present invention including a substrate, a plurality of display pixel portions formed in a two-dimensional state over the substrate, a plurality of switching thin film transistors each of which controls each of the display pixel portions, and a driving circuit portion for driving the thin film transistors in order having a signal line scanning circuit and a gate line scanning circuit over the substrate is characterized in that the signal line scanning circuit includes a video signal processing portion and a video signal writing thin film transistor which writes a video signal from the video signal processing portion to a signal scanning line; the video signal writing thin film transistor are formed by connecting in parallel a plurality of thin film transistors which are formed by hydrotreatment; and each channel width of the thin film transistors connected in parallel is 1 μm or more and 30 μm or less.

[0010]

In a liquid crystal display device of the present invention, as well as the video signal writing thin film transistor, a buffer circuit having a wide channel width and a thin film transistor of a protection MOS diode may be formed by connecting a plurality of thin film transistors, whose each channel width is 1 μm or more and 30 μm or less in parallel.

[0011]

In the liquid crystal display device of the present invention, a liquid crystal cell is structured by setting the entire display pixel portion of a substrate including the above-described display pixel portion and a driving circuit portion or the like, and an opposite substrate with a desired interval, and by injecting a liquid crystal in a gap portion of those. Further, the liquid crystal display device of the present invention is obtained by forming an outward assembly.

[0012]

[Operation]

By connecting a plurality of thin film transistors having a narrow channel width in parallel, the hydrotreatment can be carried out more completely. Moreover, the hydrotreatment can be carried out without variation, since the channel width becomes a complete stripe shape between source and drain regions.

[0013]

Further, since channel widths of thin film transistors formed over the same substrate including a driving circuit portion and a pixel portion or the like are almost the same, the hydrotreatment or the like can be carried out with the same process. Therefore, especially, the ON-resistance of the switching thin film transistor for video signal writing can be lowered, a period for writing can be shortened, and division number of video signals can be reduced.

[0014]

[Embodiment]

An embodiment of the present invention is shown with FIGS. 1 to 6. A characteristic of a transistor before and after hydrotreatment of a polycrystalline silicon thin

film transistor is shown in FIG. 4. By conducting the hydrotreatment, mobility is increased and threshold voltage is reduced and the like, and thus, a leak-current at OFF-time can be attempted to reduce. Herein, in the polycrystalline silicon thin film transistor shown in FIG. 4, it is preferable for source and drain portions to have an LDD (Lightly Doped Drain) structure having an n- region. The LDD structure makes up drain junctions or the like, by changing gradually charge distribution in the vicinity of the drain portion or the like. Since the charge distribution changes gradually, also a junction electric field of the junction portion changes gradually and an extraordinary leak-current does not flow. In a case where the polycrystalline silicon thin film transistor does not have such an LDD structure, leak-current increases in a region where a gate bias is negative. If the leak-current increases, a video signal retention characteristic within one gate scanning time can not be secured.

[0015]

FIG. 5 shows mobility and a channel-width dependency of a threshold voltage characteristic after the hydrotreatment of the polycrystalline silicon thin film transistor. In the polycrystalline silicon thin film transistor in FIG. 5, when hydrotreatment is carried out in the same condition, the hydrogenation is insufficient as the channel width is widened. Thus, the mobility is degraded and threshold voltage is increased. On the other hand, if the channel width is too narrow, drain current is difficult to flow, which means that the number of thin film transistors connected in parallel is too many. Therefore, it is important for the channel width in the present invention to be 1 μm or more and 30 μm or less.

[0016]

It is to be noted that when the hydrotreatment of the polycrystalline silicon thin film transistor is performed for a long period of time, FIG. 6 shows a state where hydrogen functions as a donor and a transistor characteristic shifts from an enhancement type to a depression type.

[0017]

FIG. 1 is a partial circuit diagram of an active matrix type liquid crystal display

device with a driving circuit integrated including the polycrystalline silicon thin film transistor of the present invention. In addition, FIG. 2 is a plain view of a switching thin film transistor for video signal writing 3. In FIG. 1, it is structured such that driving circuits such as a shift register 1, a buffer 2, and a switching thin film transistor for video signal writing 3 are formed over a substrate, and a switching thin film transistor 5 which controls a plurality of display pixel portions 4 formed in a two-dimensional state over the same substrate is driven in a dot-sequential manner. Herein, the switching thin film transistor for video signal writing 3 was formed by connecting a plurality of thin film transistors in parallel, and each channel width of the connected thin film transistors in parallel was approximately 8 μm. Further, in the switching thin film transistor for video signal writing 3, by connecting the 40 thin film transistors in parallel, ON-resistance of equal to or less than 500 Ω was achieved at the time of writing a video signal.

[0018]

Usually, since a video signal line wiring capacitance is approximately 10 pF, the frequency of approximately 30 MHz can be obtained due to a characteristic of frequency ($f=1/(2\pi RC)$) as a switching element. For this reason, a video signal band of high vision can be conducted without division, and thus, burden of an external circuit is reduced.

[0019]

FIG. 3 is a partial circuit diagram of an active matrix type liquid crystal display device with a driving circuit integrated including the polycrystalline silicon thin film transistor of the present invention. In FIG. 3, a thin film transistor of a buffer circuit 2 is structured such that a plurality of thin film transistors, whose channel width is approximately 8 μm, is connected in parallel as well as the switching thin film transistor for video signal writing 3. For the buffer circuit 2, an inverter circuit having a wide channel width is used. By making the thin film transistor of the buffer circuit have a parallel connection structure, hydrogenation is completed and the hydrotreatment can be conducted with the same manufacturing process.

[0020]

Similarly, if hydrogenation of a protection MOS diode for electrostatics measures formed in an input protection circuit portion is insufficient, it becomes high resistance and degradation of a primary function is brought about. However, low resistance can be achieved by connecting a plurality of thin film transistors in parallel as shown in FIG. 8.

[0021]

[Effect of the Invention]

In the liquid crystal display device of the present invention, a video signal writing thin film transistor is formed by connecting in parallel a plurality of thin film transistors which are formed by hydrotreatment and each channel width of the thin film transistors connected in parallel is made narrow so as to have 1 μm or more and 30 μm or less. Thus, complete hydrotreatment can be conducted, and variation of hydrotreatment can be decreased. Therefore, ON-resistance of a switching thin film transistor for video signal writing can be made low and a period for writing can be shortened. Further, leak-current at OFF-time can be reduced and power consumption and heat generation can be suppressed. Therefore, a liquid crystal display device having a high-quality image display which is excellent in contrast can be obtained.

[0022]

Moreover, since the channel widths of the thin film transistors formed over the same substrate are almost the same, hydrotreatment or the like can be conducted in the same manufacturing process. Therefore, the manufacturing process can be simplified and reliability of the liquid crystal display device is improved.

[Brief description of the Drawings]

[FIG. 1] A partial circuit diagram of a liquid crystal display device of the present invention.

[FIG. 2] A plain view of a switching thin film transistor for video signal writing 3 in a liquid crystal display device of the present invention.

[FIG. 3] Other partial circuit diagram of a liquid crystal display device of the present invention.

[FIG. 4] A graph showing a transistor characteristic before and after hydrotreatment of a polycrystalline silicon thin film transistor.

[FIG. 5] A graph showing mobility and channel-width dependency of a threshold voltage characteristic after hydrotreatment of a polycrystalline silicon thin film transistor.

[FIG. 6] A graph showing a transistor characteristic in a case where hydrotreatment of a polycrystalline silicon thin film transistor is conducted for a long period of time.

[FIG. 7] A partial circuit diagram of a conventional liquid crystal display device.

[FIG. 8] A partial circuit diagram of a protection MOS diode in an input protection circuit portion of a liquid crystal display device of the present invention.

[Description of the Numerals]

1: shift register

2: buffer

3: switching thin film transistor for video signal writing

4: display pixel portion

5: switching thin film transistor

6: signal line

7: gate line

8: gate scanning line driving circuit